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Original Paper

ENCIRCLING GILLNET SELECTIVITY FOR OXEYE SCAD (*Selar boops* CUVIER, 1833) IN THE COAST OF WAAI, AMBON ISLAND

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ABSTRACT

The mesh selectivity of monofilament encircling gillnet for Oxeye scad (Cuvier,1833). Selar boops, was investigated using multi-panel of six different nets with mesh size of 1.50", 1.75" and 2.00" (hang-in ratios 35% and 65% for each mesh size). Experimental fishing operation was carried out in the coastal area of Waai (Ambon Island) between September to November 2009. Probability of captured of oxeyescad was estimated using Holt's method. Estimated optimum selectivity lengths for nets with 35% hang-in ratio were 14.33 cm for 1.50" mesh size, 16.74 cm for 1.75" mesh size and 19.11cm for 2.00" mesh size. Net with 65% hang-in ratio showed slightly larger optimum selectivity lengths (14.46 cm for 1.50" mesh size and 16.87 cm for 1.75" mesh size) then the other one.

Keywords: Encircling gillnet; mesh selectivity; s*elar boops*; hang-in ratio

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INTRODUCTION

Oxeye scad, *Selar boops*, locally known as *palala (local name)*, is one of the commercially important fishes in Indonesia. This scad is a marine migrant species in estuarine waters (Hutubessy, 2001) where the schooling of this fish occurred in coastal areas. In Waai Village, several gears are used to catch this fish such as purse seine at the surrounding fish aggregation device (*rumpon*), some time they were captured by "bagan" lift net (light fishing) and multiple hand line around the lift net. It seems that this scad gives positive reaction to light and in order to utilize their behavior. Fishermen in Waai Village also use encircling gillnet to catch them. Gillnets are widely used for harvesting fish. Gillnets are highly selective for fish of certain size (Fridman and Carrothers, 1986). It is due to the similar mesh size applied to let certain size of fish gilled on it. It is therefore, knowledge of the size selection of gillnets is necessary not just for regulating their use effectively but also for population assessment (Hamley, 1975). Using various indirect methods, gillnet selectivity models have been developed and applied to a wide variety of species such as flying fish, *Cheilopogon suttoni* (Hutubessy, *et al, 2005)*, European chub, *Leociscus cephalus* (Ozekinzi, *et al*, 2007), red mullet, *Mullus barbatus* (Dincer and Bahar, 2008), and *Parailia pellucida* (Allison, *et al*., 2009). Selectivity of fish gear affects the intra specific diversity of fish population by selecting against certain attrubute such as large size, fast growing and schooling behavior (Ryman, 1991). The analysis of the selectivity of encirclying gillnet will provide biological fishery information for the management and development of the Ambonese artisanal fishery. If the fishery of scad is to be managed efficiently, knowledge of the selectivity of mesh size used can help in recommendation to maximize or minimize the catch of certain sizes and species. Although Oxeye scad has been heavily exploited, poor information on gear selectivity has been carried out for this fish, and this present study try to look at the selectivity of encirclying gillnet.

The main purpose of this paper is to estimate the optimum monofilament gillnet

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mesh size for oxeye scad from the coastal aggregate using monofilament multi-panel encircling gillnets with variety of mesh size and hang-in ratio, some of which are applied by local traditional gillnet fishery.

MATERIALS AND METHODS

Data for calculation of mesh size selectivity were obtained from encircling gillnet used in an experimental fishing on coastal fish in Waai Village waters with coordinate point 128° 32' E and 3°35' S. Oxeye scad was collected with a 220.65 m long gill net consisting of panels of three different mesh sizes and each mesh size has different hang-in ratio (35% and 65%). Stretched mesh size ranged from 3.81cm (1.5 inch) to 5.08 cm (2.0 inch) in step of 0.6 cm. The depth of panels when fishing was 3.73 m. Webbing for all panels was monofilament. When set, the nets were anchored at both ends in shape of circle or opened circle. Using a tomweight, fish were chased toward the net.

Samplings were conducted from September to November 2009 with 20 times of setting. Each setting, the position of each panel of net was changed in order to let fish to be gilled within all nets. This means that, if the 1.5inch mesh net with 35% and 65% hang-in ratio were set at the end of the multiple panels, for the next setting, those nets were move to the middle panel. Due to fishes were chased, more fish gilled in the middle of the panels than at the end. Therefore, moving around each panel will give similar proportion of fish were gilled on to each net.

Scads were captured by "gilled" (head caught initially in a single mesh) or "entangled", and its total length (cm) were pooled for analysis. Due to fish are gilled on to mesh, data of gird (cm) is also collected. The correlation between total length (TL) and gird is y = 0.567x + 0.0408 with coefficient correlatin R^2 = 0.7632.

Mesh selectivity were estimated by using indirectly method involve estimation of catch taken by nets of slightly different mesh size (Sparre and Venema,, 1998) using the function defined as

$P(L)m = Exp\{-(L-Lm)2/2S^2\}$

where Lm is optimum length of fish caught in a smesh size m

Lm = k.m

where k is the selectivity factor

k = -2A/ B(ma + mb)

where ma and mb is the mesh size of smaller size of net and larger size of net, respectively. Variance between the two sizes of net will be

$S^2 = -2 \{(A) (mb - ma)\}/B2 (ma + mb)$

The value of A (constant) and B (slope) were calculated from the correlation of natural logarithmic between mid point of length (L) and comparing the catches in term of quantity according to two diffferent mesh sizes (Ca/Cb) at a certain interval length

Ln(Ca/Cb) = A- B (L)

RESULTS AND DISCUSSION

All together 286 individuals of oxeye scad (*Selar boops*) were captured and representated 28.5% composition of the whole catch. Larger fish were caught in larger mesh size and mesh size 1.75" captured the most abundance (**Fig. 1**). The length-frequency distribution seemed to be single modally distributed for all mesh size

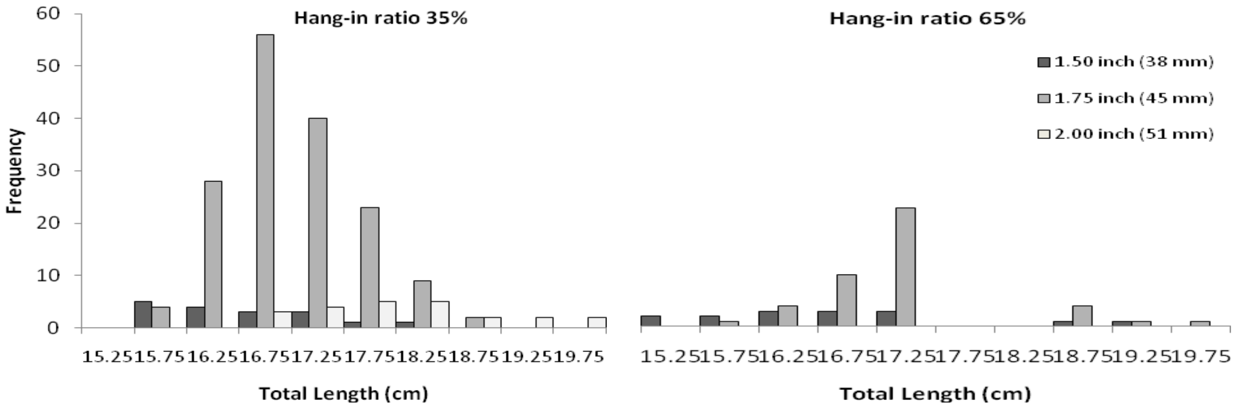

Fig. 1. Length-frequency distribution of 286 Oxeye scad by mesh sizes (inch) and different hang-in ratio used for developing gillnet selectivity model

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Catch rates (i.e.: CPUE: number of scad/mesh panels/setting) varied by mesh(**Fig. 2**). Analysis of variance on natural log transformed CPUE data found significant differences in CPUE and mesh size for Oxeye scad ($F_{0.05;\ 9,1}$ = 8.37; P = 0.02). Catch rates were highest for mesh size 1.75" with hang-in ratio 35% (8.1 per setting). The reason for testing these 2 hang-in ratios is to obtain the best model of netting for catching Oxeye scad. The local fishermen usually use monofilament drift gillnet with 35% hanging ratio to catch small pelagis fishes.

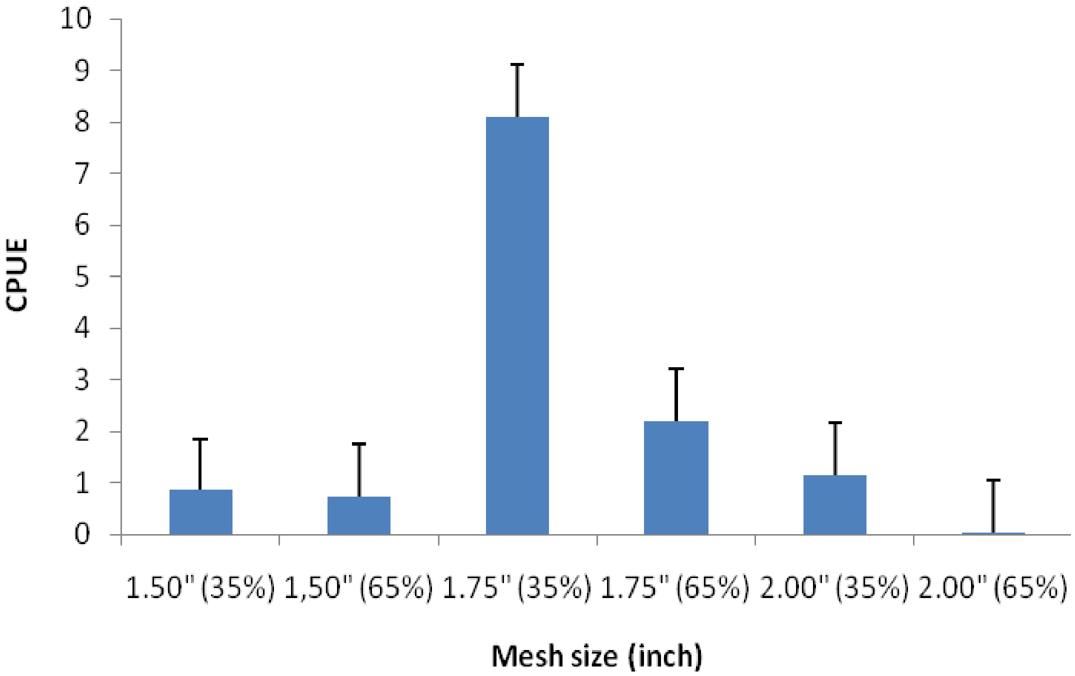

Fig.2. Observed catch rates by mesh panels for Oxeye Scad. CPUE is defined as the number of scad/panels/setting. The vertical error bars represent +1 standard error

The calculation of selectivity parameters were based on the net pairs 1.50-1.75" and 1.75-2.00" with hang-in ratio 35%. The regression slope, intercept and coefficient for optimum length and selectivity parameters (selection factors and standard deviation) were assessed from length frequency distribution for each mesh size combination. Values from **Table 1.** were used to estimate the common selectivity factor, the common standard deviation and optimum selection length per mesh size. The common selectivity factor and the common standard deviation were 3.76 and 2.11, respectively. Estimated optimum selectivity lengths were 14.33 cm for 1.50" mesh size, 16.74 cm for 1.75" mesh size and 19.11 cm for 2.00" mesh size.

Table 1. The selectivity parameters monofilament encircling gillnet with different mesh size (hang-in ratio 35%)

Mesh Size	Selectivity parameters								
	ma	mb	A	B	R^2	Lma	Lmb	Sf	Sd
1.50" vs 1.75"	3.81	4.44	-12.80	0.98	0.67	13.48	15.73	3.54	2.56
1.75" vs 2.00"	4.44	5.08	-28.34	1.51	0.99	17.47	19.97	3.93	1.65

The selection curves of monofilament encircling gillnet for oxeye scad obtained with the probability of captured (P) equation and are shown in **Fig.3.**

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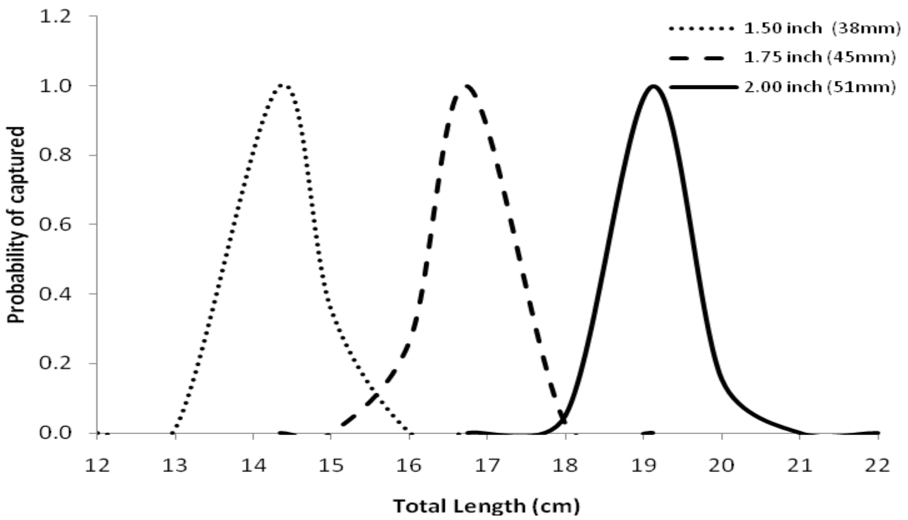

Fig. 3. Selectivity curve experimental encirclyng gillnets with hang-in ratio 35%

For gillnet with hang-in ratio 65%, no data provided by mesh size 2.00" (only one fish caught). The selection curves of encircling gillnet mesh size 1.50" and 1.75" are shown in **Fig. 4.** Estimated optimum selectivity lengths were 14.46 cm for 1.50" mesh size and 16.87 cm for 1.75" mesh size.

Length-frequency distribution of Oxeye scad caught during this study for all mesh sizes tended to be uni-modal or normal distributed. Most of fish were captured by wedged or gilled on its operculum and dorsal (Lembang, 2009). If more fish were entangled on nets, the distribution of length could be bi-modal (Hansen, *et al*., 1997). Fish which entangled on its teeth and maxillaries will generally causes selectivity curves to be broadly domed and skewed to the right (Sbrana, *et al*., 2007; Carol and Garcia-Berthou, 2007)). For comparison, the selection curve for lake whitefish (*Coregonus clupeaformis*) (Regier and Robson, 1966), a salmonid species with small mouth is relatively normal while the selectivity curve for other salmonid with larger mouth such as rainbow trout (*Onchorhynchus mykiss*) (Fujimori, *et al.*, 1992), sockeye salmon (*O. nerka*), chum salmon (*O. keta*), pink salmon *(O. gorbuscha*) (reviewed by Hamley, 1975), Arctic char (*Salvelinus alpinus*) and brown trout (reviewed by Jensen, 1986) are more skewed. For several fish species, bi-modal curves may produce better fit than uni-modal model (Fujimori and Tokai, 2001). Therefore, the skewness of selectivity curve depends on the body shape of fish which effect to the way of how fish captured on to the net.

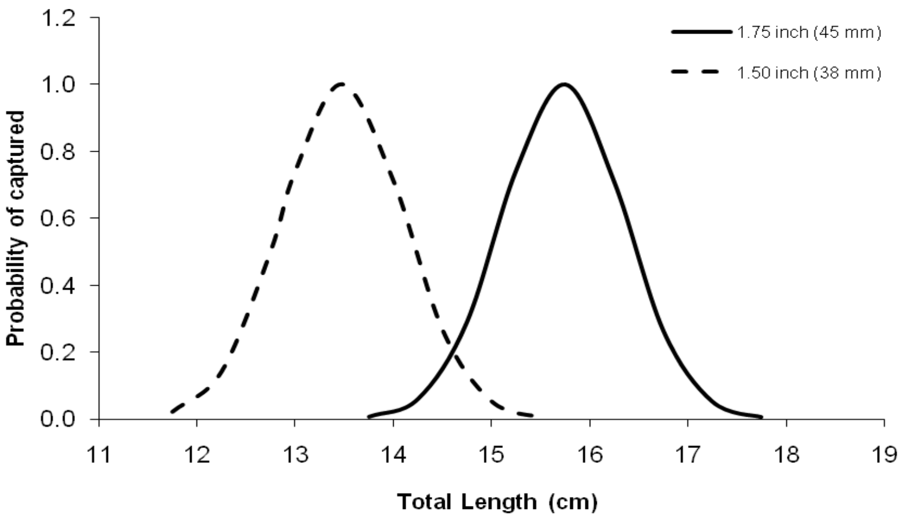

Fig.4. Selectivity curve experimental encirclyng gillnets with hang-in ratio 65%

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The catch rates showed the 1.75” mesh size with hang-in ratio 35% as the most efficient for the Oxeye scad, *Selar boops*. The length-frequency distribution showed that larger mesh size caught larger size of fish. Although each net position had been changed randomly, the covered area inside the encircling gillnet allows fish to escape through the all parts of net. This means that all nets have similar opportunity to catch the fish. However, the 1.75” meshed gillnet captured the most of the chased (affected by tomweight) fish. It is probably stated that fish size of 16.25 cm to 17.75 cm was the dominant size in the schooling of *Selar boops* at the coastal area of Waai. To increase the efficiency of catching larger size of fish at the deeper water, larger mesh size of net should be occupied.

Length at optimum selectivity increased with mesh size. Relationship between general morphology of Oxeye scad and mesh size affect the selectivity, behavior of fish and hang-in ratio can also be related to selectivity (Hamley, 1975). The morphology of Oxeye scad and its behavior in swimming let them gilled within the net rather than entangled. So the result of optimum size of selectivity showed no overlapping between mesh sizes (Carlson and Cortes, 2003).

Oxeye scad is generally contributed small proportion from other scad species (carangidae) captured. It is important to inform the selectivity of other scad species. Big-eye scad, *Selar crumenophthalmus*, which caught by using purse seine, trawl and ring net with small mesh size 1cm to 2cm showed that length at first capture for purse seine and trawl was 21 to 24 cm of total length while 13cm for ring net (Dalzell and Penaflor, 1989). Tupamahu (2009) reported the selectivity of scad *Decapterus macarelus* using drift gillnet, that the optimum size of selectivity were 18.5cm FL for 1.5inch mesh size, 22.5cm FL for 1.75inch mesh size and 25.5cm for 2inch mesh size. For management purposes, all the mesh sizes should be agreed with the actual minimum size of captured. There is no minimum size of captured for scads which related to the minimum mesh size established in Indonesian fishery regulations. Therefore, further studies on gear selectivity need to be conducted.

CONCLUSSION

Despite the fact that there are currently no minimum size regulation for small pelagic in commercial fisheries, recommendation of mesh size will allow to reduce the catch of juvenile fish and let the adult contribute to recruitment process. This present study recommends the using of 1.75” meshed net due to the optimum catch sized of 16.74 cm could be categorized as adult fish. However, study regarding minimum size of reproduction should be conducted in order to strengthen this recommendation.

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REFERENCES

Allison, M.E., I.F. Vincent-Akpu, and A.D.I. George. 2009. Gillnet selectivity and abundance in the *Parailla pellucida* (Boulenger 1991) (Schilbaidae) fishery of the freshwater reaches of the lower Nun River, Niger Delta, Nigeria. *J..Fish. Intern.* 4 (1): 5 – 7

Carlson, J.K. and E. Cortes. 2003. Gillnet selectivity of small coastal sharks off the Southern United States. *Fish.Res*. 60: 403-414

Carol, J. and E. García-Berthou. 2007. Gillnet selectivity and its relationship with body shape for eight freshwater fish species. *J. App. Ichthyol*, 23: 654–660.

Dalzell, P. and G. Penaflor. 1989. The fisheries biology of big-eye scad, *Selar crumenophthalmus* (Bloch) in the Philippines. *Asian Fish. Sci.* 3: 115-131

Dincer, A.C. and M. Bahar . 2008. Multifilament gillnet selectivity for the red mullet (*Mullus barbatus*) in the Eastern Black Sea coast of Turkey,

ISSN : 1410-5217
Accredited : 83/Dikti/Kep/2009

Trabzon. *Turkish J. Fish. Aqua. Sci.* 8: 355-359

Fridman, A.L. and P.J.G. Carrothers. 1986. *Calculation for fishing gear designs*. FAO By fishing News Books, Ltd Farnham, England.

Fujimori Y. and T. Tokai. 2001. Estimation of gillnet selectivity curve by maximum likelihood method. *Fish. Res.,* 67: 644–654.

Fujimori Y., K. Matuda, and L.P. Losanes. 1992. Method of estimating gillnet selectivity curve in a water tank experiment by Monte Carlo simulation. *Nihon Suisan Gakkai-shi,* 58: 193–198

Hamley, J.H. 1975. Review of gillnet selectivity. *J. Fish. Res. Board Can*. 32: 1943–1969.

Hansen, M.J., C.P. Madinjian, J.H. Selgeby and T.E. Helser. 1997. Gillnet selectivity for lake trout (*Salvelinus namaychus*) in Lake Superior. *Can. J. Fish. Aqua. Sci.* 54: 2483-2490

Hutubessy, B.G. 2001. Patterns of fish assemblages, age structure and recruitment of tropical estuarine fish. MSc. Thesis. Dept. Marine Biology. James Cook University of North Queensland, Townsville Australia.

Hutubessy, B.G., J.W. Mosse dan A. Syahailatua. 2005. Selektifitas gillnet dalam penangkapan ikan terbang, *Cheilopogon suttoni*, di perairan Naku, Pulau Ambon. Torani, Jurnal Ilmu Kelautan dan Perikanan 15: 356-360. (in Indonesian)

Jensen, J.W. 1986. Gillnet selectivity and the efficiency of alternative combinations of mesh sizes for some freshwater fish. *J. Fish. Biol.*28: 637 – 646

Lembang, A. 2009. Estimasi selektivitas jaring insang lingkar (encircling gillnet) secara deskriptif berdasarkan morfologi ikan di Perairan Pesisir Waai. Skripsi S1 Universitas Pattimura Ambon. 52 hal. (in Indonesian)

Ozekinzi, U., U. Altinagac, A. Ayaz, O. Cengiz, H. Ayyildiz, H.Kaya and D. Odabasi. 2007. Monofilament gillnet selectivityparameters for European chub (*Leociscus cephalus*, L 1758) in Atikhizar resevoir, Canakkale, Turkey. Pakistan *J.Biol.Sci.* 10 (8): 1305 - 1308

Regier, H.A. and D.S. Robson. 1966. Selectivity of gillnet, especially to Lake Whitefish. *J. Fish. Res. Board Can*. 23: 423-451

Ryman, N. 1991. Conservation genetic consideration in fisheries management. *J.Fish.Biol.* 39: 211-234

Sbrana, M., P. Belcari, S. de Ranieri, P. Sartor, and C. Viva. 2007. Comparison of the catches of European hake (*Merluccius merluccius*, L. 1758) taken with experimental gillnets of different mesh sizes in the Northern Tyrrhenian Sea (western Mediterranean*)*, *Sci.Mar*. 71: 47-56.

Sparre, P. and S.C. Venema. 1998. Introduction to Tropical Fish Stock Assessment I: Manual. FAO Fish. Tech. Paper, 306/1 Rev.2. Rome, 407 pp

Tupamahu, A. 2009. Selectivity of *Decapterus macarelus* (SCAD) drift gillnet in Kayeli Bay Maluku by Kitahara's method. *J. Coast. Dev.* 12(2): 128-134